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Blessed Fate: The Study on how Heritage Churches resist natural calamities

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Blessed Fate: The Study on how Heritage Churches resist natural calamities

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Abstract. Heritage structures are known to be resilient structures in terms of their structural stability. These buildings proved their strength throughout their existence. However, some heritage structures lead to undesirable fate due to some uncontrollable factors such as natural calamities.

The Philippines is known to be one of the countries that are prone to natural disasters. From typhoon, earthquake, flash floods, volcano eruptions, and other natural disasters. Every calamity that passes through the country leaves some damages, especially to infrastructures.

As part of the colorful history of the Philippines, its thousands of islands have become home to various heritage sites and structures left by different invaders and foreign influences. These structures were built in traditional construction methods without the help of technology and survived for centuries.

Various research strategies were used to show how these some Century-old churches of the Philippines were able to withstand and endure different calamities. This research shows some possible reasons behind the structural stability and integrity of these historic churches, and how these faced natural disasters and remain to stand. Findings for the study includes its History, Structural Components, Architectural Features and Building Materials. These factors have shown differences between the traditional and modern construction method which partly proved its contribution to the stability of these structures.

Keywords: Heritage Structures, Century-old Churches, Natural Calamities, Structural Integrity

1. Introduction

Most of the Heritage buildings are known to be resilient in terms of their structural stability. To stand for several years, these buildings proved their strength throughout their existence by reaching up to a century. There are a lot of ways of protecting and preserving these heritage sites here in the

Philippines. Different agencies and various national organizations are monitoring some by providing different rules and regulations focusing on conservation of these sites and structures. Aside from the international guidelines, the Philippines has its law, the RA 10066.

The creation of Republic Act 10066, also known as the "National Cultural Heritage Act of 2009", is an initiative of the National Commission for Culture and the Arts (NCCA) to protect and conserve the National Cultural Heritage. The law covers the conservation, development, promotion, and popularization of the nation's historical and cultural heritage and resources, as well as artistic creations. However, when it comes to natural calamities, these laws have nothing to say.

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Figure 1.0

Figure 2.0

Source : https://newsinfo.inquirer.net/510203/death-toll-in-bohol-quake-up-to-175-damage-to-infrastructure-over-p500m-ndrrmc and https://www.bbc.com/news/world-asia-24530042

Some heritage structures lead to undesirable fate due to some uncontrollable factors such as natural calamities. One of the worst incidents recorded is when magnitude 7.2 earthquake hit the central Philippines last 2013. One of the most affected provinces is Bohol which has left many structures heavily damaged, especially the centuries-old churches situated all over the vicinity. Many were ruined, while some were wholly razed to the ground. These architectural treasures have dominated Bohol's skyline, eventually famous landmarks in their locations. Having been the focal points of various communities, they are sources of inspiration and symbols of the people's faith. These structures stood for years, but calamities such as this earthquake have proven that everything should always welcome possibilities.

In the Philippines, there are several Heritage Sites which played a significant role in the country's history and helped form the country's identity. However, not all of these heritage sites are being preserved or protected by the government and/or different organizations. Unfortunately, some heritage sites are neglected and are left to withstand further damage and dilapidation caused by time, neighboring developments and natural disasters and calamities. Oftentimes, in the competition between new developments that will bring economic growth and heritage sites which preserves social and cultural identity, the economic growth wins out rather than the restoration and preservation of these sites.

2. Statement of the Problem and Methodology

For Christians, it is part of their beliefs that their faith can save them from any danger and guarantee their safety. It applies to their daily lives especially during their rough times, particularly whenever natural calamities and disasters are present. For instance, aside from their own, does their "so-called" house of worship includes in the exemption?

To be able to arrive at a conclusion, one must be able to uncover the reasons behind the construction of these churches. Listed below are several questions to be addressed:

- How can these churches resist natural calamities?
- What are the reasons behind the structural stability of these churches?
- Does Heritage Churches possess more strength in terms of structural stability rather than the new ones?

2.1 Goal of the Study

The primary goal of the study is unveiling the reasons behind the stability of these century old churches, with emphasis on techniques on how a church can pursue a more holistic development through the integration of their structural system to its future plans with heritage conservation.

This study aims to establish how the construction system and methodology of these churches proved their effectivity to make them lasts this long.

2.2 Scope and delimitations of Study

Careful consideration was made during the selection of the chosen study area. The study will only delve on the structural stability and methodology of selected century old churches that are still standing and existing.

The study will also look at the differences of the old method of construction to the new one to look after the effectiveness of both approaches.

2.3 Research Methodology

Various research strategies were applied for the study. Qualitative and quantitative methods were used, and among them are the following:

2.3.1 Desk Research – Various media, literature, and documents were used as reference materials to gather data, as well as secondary descriptions.

2.3.2 Walking Tour/Experiential Research and Direct Observation – Familiarization with the general condition of selected churches

2.3.3. Interviews – Interview with concerned institutions to request pertinent documents that will provide valid, reliable, and concrete information about selected churches. Random conversation with the people who are related to selected churches.

3. Data Analysis

3.1 Heritage Churches in the Philippines

The colorful history of the Philippines, where aside from its indigenous culture, it also embraced foreign influences from its long period of being a colonized nation; it is not surprising that its thousands of islands have become home to various heritage sites and structures.

During the days of the Spanish Empire in the country, they have had an attempt to create a Baroque style inspired ecclesiastical structures needed to minister the new convents to Catholicism according to Augusto Villalom. Baroque style was chosen as the architectural style to be developed in the Philippine tropical environment. Stylistically, the colonial churches of the Philippines were closer to those of Mexico and South America than to Spain.

Currently, four baroque churches in the country and four of them are listed in the UNESCO World Heritage List.

Upon the arrival of the Spaniards, evangelization is one of their missions. They started it by constructing facilities such as churches. Fortunately, they didn't fail to achieve this mission and successfully built numerous churches. However, as time goes by and calamities are coming, some of the churches were destroyed. This incident led the builders to improve and develop their construction methods.

3.2 The development of Philippine Church

The development of church from wooden construction to stone houses of worship started on 1571 with the foundation of the pilgrim administration. The engineering style is orientated on the Spanish or Mexican ornate. The primary expert developers and artisans are fundamentally originating from Mexico. That is not astonishing on the grounds that the colonization begins from Mexico according to one of the administrators of the Philippine Travel Website.

The development of these churches need to consider the exceptional incidents of the nation such as common disasters. That is the motivation behind why the Philippine church compositional style was developed and the end result named "Earthquake Baroque".

3.3 Philippine Churches

Currently, aside from the recorded baroque churches, there are also numerous churches all over the country that proved their strength through the years.

Table 1.0

Church Name	Description	Features
 Figure 3.0 Source: https://www.choosephilippines.com/go/heritage-sites/72/falling-love-paoay-church		
1. Paoay Church	Located in Ilocos Norte, officially called as the Church of San Agustin and built by Augustinian Order. The church construction commenced in 1964 and was completed in 1702. It is included in the list of UNESCO World Heritage Site	• Earthquake Baroque Church • Detached Bell Tower • High Stone, Coral Stones, and Brick Walls • Buttresses

Figure 4.0
Source: https://www.vigattintourism.com/tourism/articles/Santo-Tomas-de-Villanueva-Church-Miag-ao-Church

2. Santo Tomas de Villanueva Church	Located in Miag-ao, Iloilo Province and it was completed in 1797 by the Augustinian Order. It is included in the list of UNESCO World Heritage Site	• Earthquake Baroque Church • Adobe, Egg, Coral stones and Limestone • 6-meter deep foundation and its 1.5-meter thickness wall • Twin Belfries • Flying buttresses

Figure 5.0
Source: https://www.flickr.com/photos/118169647@N03/14612989796

3. Nuestra Señora de la Asuncion Church	Located in the town of Santa Maria, Ilocos Sur. Built in the 18th Century by the Augustinian Order. It is included in the list of UNESCO World Heritage Site	• Earthquake Baroque Church • Detached Bell Tower • Quadrangular Buttress • Structural Brick

Figure 6.0

Source: http://primer.com.ph/travel/2014/10/08/san-agustin-museum/		
4. San Agustin Church	The construction started in 1571 and initiated by Augustinian Friars. Being labeled as the oldest church in the Philippines.	• Rebuilt Three times • Two bell towers • Integrated Buttress • Barrel Vault • Dome • Arched Vestibule • Raft-Type Foundation
 Figure 7.0 Source: https://traveleronfoot.wordpress.com/tag/st-william-cathedral-in-laoag/		
5. San Guillermo Ermitaño Church	Located in Laoag, Ilocos Norte, it was built in 1700 under the direction of the Augustinian Order	• Baroque Style Columns • Overscaled Pilasters
 Figure 8.0 Source: https://www.flickr.com/photos/geneardenio/7170894345/		
6. San Geronimo Church	Located in Morong, Rizal, the church was built in 1615 under the direction of Franciscans and extensively renovated in 1850-1852.	• Three-Level Façade • Octagonal Bell Tower
 Figure 9.0 Source: https://en.wikipedia.org/wiki/Guiuan_Church		

7. Church of the Inmaculada Concepcion	Located in Guiuan, Samar, the church was built in the 18th century under the direction of the Jesuits.	• Fortress Baroque • Polychrome Retablos
 Figure 10.0 Source: http://www.cebuwanderlust.com/culture-and-heritage/visita-iglesia-7-old-churches-visit-cebu-holy-week/attachment/nuestra-senora-del-patrocinio-de-maria-parish-boljoon-church-cebu/		
8. Church of Nuestra Señora Del Patrocinio	Located in Boljo-on, Cebu Province, the church was built in 1599 under the direction of the Augustinians.	• Fortress Church • Coral stones • Terra Cotta Roof Tiles • Sumptuous Interior
 Figure 11.0 Source: https://loydtraveltrail.blogspot.com/2016/02/national-cultural-treasure-series-san.html		
9. San Matias Apostol Church	Located in Tumauini, Isabela, the church was constructed from 1783 to 1788 under a Dominican missionary.	• Brick Construction • Lime Plaster • Flying Buttress

3.4 Cultural Significance

3.4.1 Value for History

Changes are indeed uncontrollable. In terms of transformation, not all Filipinos especially Catholics, are aware of the physical characteristics of their remaining heritage churches, but there is something that they are all aware of, the histories inculcated in every church they have.

> Aside from its function, these churches are considered important because they are incorporated with memories and histories. In the Philippines, most of the people are aware of its historical facts. For the primary schools, part of the discussion of the Philippine History are the structures that were built during that time. As a summary to some interviews that the researcher had, it is undeniable that Filipinos are the type of people who love to embrace knowledge that others have forgotten. Their passion in the value of their church's history show through their concern in maintaining and preserving it.

3.4.2 Symbol of Pride

During interviews, the researcher observed that some of the Filipinos are proud of their built heritage to the extent of comparing their town to other similar countries with the same features. The attachment is present while sharing stories and trivia regarding their heritage sites and structures. This just shows how they value their built heritage and takes pride in it. Showing concern to their built heritage is one way of showing patriotism to their country.

3.4.3 Country's Identity

Philippines may be labeled with different taglines but one of the things that you cannot detach to the country is its rich culture and history.

> Filipinos are united in the idea that these heritage sites and structures are entailed in the name of their Country. During interviews, the researcher observed that each church that they know includes a story tied to the history of the Philippines. This can be put in the context of a missing page of the book if ever any of these built heritage are removed.

3.4.4 Appreciation for Art

Art can be seen or expressed in different forms. In terms of defining art, Filipinos possess a lot such as folk songs, poetry, dance, paintings, sculpture, and their old and historical structures.

> During interviews, most of the respondents are fascinated with the beauty of their Century-old churches. Regardless of what their backgrounds and knowledge in art are, the way that they describe the aesthetic values and physical characteristics of these buildings show their appreciation to its beauty and architecture.

3.4.5 Treasure

They say that these historical buildings are one of the treasures of our culture. Hence, these treasures should be given a proper care and maintenance to prolong their lifespan and existence.

> Every community of these century old churches are deeply attached to these properties although these churches will not stay the same forever. Deteriorations might be encountered along the way and must be solved immediately. Maintaining a century old church is kind of costly but for the community it's not easy to let go of their property, so they make sure that they will have a deeper study on what is the best solution. And having a proper decision will fall into the valuing of their so-called treasure.

4. Findings and Results

4.1 Rebuilt Churches

As part of the country's history, most of the century-old churches went through trial and error process and experienced disasters such as fire, typhoon, and earthquake. The year 1645 marked a turning point in the development of architecture in the Philippines. It is the time where the existing construction method will be changed and upgraded.

> "Arquiteqtura Mestiza" or a mixture of stone and wood construction, is one of the methods used as it also adapts the structural features of pre-colonial "bahay" or "balay" which is known for its flexibility and being able to resist earthquake. San Agustin Church in Intramuros, Manila used to be constructed with the use of wood, but with the combustibility of the wood, it was easily ignited by fire. This incident has brought the church to reconstruction and developed its methodology. Most of then examples of the abovementioned churches were reconstructed and repaired because of the impact of the natural calamities. However, these incidents brought these churches to a better condition.

Figure 12.0
Source: http://www.artesdelasfilipinas.com/archives/119/the-history-of-the-san-agustin-church

4.2 Separated Bell Tower

During Spanish times, Bell towers were used to convey a message to the community; it was also used as a watchtower to look for possible danger and to maintain the safety of the whole community and the church. Presently, the bell tower is being used as a carrier of the church bell/s.

There are different types of bell towers; some are attached to the church itself, some are twins, some are located at the center top while some are detached. Bell towers are constructed vertically with towering height. These towers are prone to collapsing especially during an earthquake. Detached bell towers were situated beside the church, oriented outwards to avoid the tower from crashing into the church in case an earthquake happens.

Figure 13.0
Source: https://www.pinoyadventurista.com/2013/05/santa-maria-church-ilocos-sur.html

4.3 Structural Features

Colonial churches were constructed based on the availability of resources and their version of technology during their times. From the ancient construction technique developed by the Romans, the great Catholic friar missionary builders such as the Augustinians, Franciscans, Dominicans and Recollects, used natural building materials such as stones to form arches to frame the tops of openings and to evenly distribute the weight of the wall above doors, windows and other openings to prevent them from collapse.

4.3.1 Buttress

Stone Buttress is widely used as a support to resist earthquake. It is exterior support built vertically at right angles to the walls, provide added strength to prevent the high walls from falling, especially when buffeted by strong wind and during tremors.

For most of the examples mentioned above, these so-called Baroque Churches were constructed with the support of buttress and usually attached within the perimeter of the church.

Figure 14.0
Source: https://www.tripadvisor.com.ph/LocationPhotoDirectLink-g1773690-d8604745-i175773179-Paoay_Church-Paoay_Ilocos_Norte_Province_Ilocos_Region_Luzon.html

4.3.2 Raft-Foundation

As part of the reconstruction process of San Agustin Church in Intramuros, Manila, the use of raft foundation was used to develop its structural stability. The builder believes that underground raft of logs will allow the massive structure to sway gently to resist damage caused by tremors.

Another distinctly Philippine approach to earthquake protection is the construction of bell towers at a distance away from the main church structure, a pragmatic response to the destruction of churches caused by towers attached to their façades falling on the structure during an earthquake.

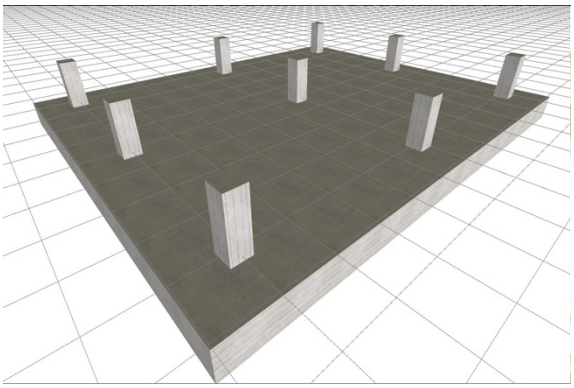

Figure 15.0
Source: https://debug.pi.gr/default.aspx?ch=77

4.3.3 Deep Foundation

Churches are known to be massive in construction. It will require a deep foundation to carry loads especially if the site has weak compressible soils or fills on to stronger and less compressible soils or rocks at depth. In the case of some churches in the Philippines, protecting the structure from the earthquake, the deep foundation is being used for functional reasons.

Deep foundations are founded too profoundly below the finished ground surface for their base bearing capacity to be affected by surface conditions, this is usually at depths >3 m below finished ground level, but in the case of Santo Tomas de Villanueva Church, it has a 6-meter depth.

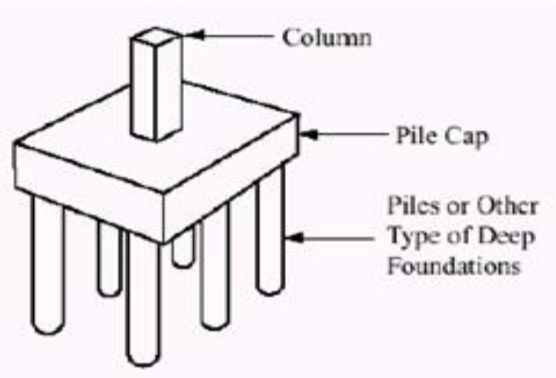

Figure 16.0
Source: http://geotechnicalcelp.blogspot.com/2015/05/types-of-foundation-and-methods-of.html

4.4 Building Materials

4.4.1Wood

The first religious structures were constructed with the use of locally available materials such as the post of hardwood, roof of thatch, and walls of wood or bamboo. These building materials proved their strength but not to resist terrible typhoons and they were highly made of combustible material.

Some types of wood being used are Molave, Guijo and Ipil, for posts, columns, beams, window and door frames, trusses, floor planks, Narra & Kamagong - for doors and floor planks, Yakal– for roof rafters, Amuguis, Baticuling, and Malatumbaga– for planks for walls and roofing and Tangile– for minor parts. When some church damaged severely by fire, the restoration process includes reconsideration of other building materials that are also fire resistive. They believed that a more substantial structure is needed. Currently, there are still churches with the solid wooden post like the Alburquerque Church in Bohol, it central columns supports are made of wood and it proved its stability for more than a century. However, woods now are just being used as part of the building materials but will not dominate the construction.

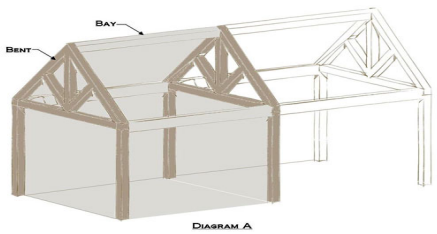

Figure 17.0
Source: http://www.loghomeoutfitters.com/timber_frames_terminology.html

4.4.2 Stone Masonry

Stone and masonry construction have been brought by the influence of a Jesuit, Antonio Sedeno, who were among the earliest missionaries to arrive in the Philippines in 1580.

Natural stones such as limestones, coral stones, granite, adobe stones of volcanic tuff and bricks have played a significant role in masonry construction for thousands of years. It has proven performance that is demonstrated by various structures, which have lasted for hundreds of years.

The combination of natural stones and natural mortar allows buildings to breathe. For example, lime mortars and plasters are vapor permeable and allow buildings to breathe. The process reduces the risk of trapped moisture and consequent damage to the building fabric.

Natural lime mortar can protect adjacent materials. Most of the stones/bricks used were still safe to use as lime mortars have a characteristic of protecting adjacent elements by handling moisture movements through the building fabric and protecting them from harmful salts. Adjacent materials frequently affected this way include timber and iron as well as stone and brick masonry. Natural stones with lime mortar are Self-Healing. Since most of the churches are exposed to elements of nature, they are subject to varying degrees of movement over time. When buildings made with lime are subject to small changes they are more likely to develop many fine cracks than the individual large cracks which occur in stiffer cement-bound structures. Water penetration can dissolve the ‘free’ lime and transport it. As the water evaporates, this lime is deposited and begins to heal the cracks.

Lastly, the versatility and flexibility of these natural stones helped these century-old buildings to withstand the vibration of the earth. Masonry construction using these natural stones is different to masonry construction now, which concrete mortar is being used.

Figure 18.0

Figure 19.0

Figure 20.0

Figure 21.0

5. Conclusion

As many say, Science and Religion are hostile or opposed to each other. From the creation of man and earth up to the current occurrences. Indeed, this fast-changing world brings a lot of wonders for the people. Things are different now as compare to before especially to our environment. People think that it's the result of what we have done to nature and the harm that we've caused to it. While on the contrary side, some people think that this is because of the lack of faith to God.

This study clearly shows factors that affect the stability of these churches. The creation of these spaces is to address issues concerning the steadiness of every structure being built; these physical characteristics were created for a purpose. Defining the strength of every church comes with various factors to be considered, and through these studies, answers were

revealed. In the context of a Spanish Colonial Churches in the Philippines, culture and traditions played an important role to portray a perfect image of a Filipino Architecture. Using the idea of a Vernacular Architecture can meet the requirement of a massive structure in the country. Also, it utilized its natural resources by using them as the primary building materials. The idea incorporated both tangible and intangible aspects of a positive identity.

Through various methods, the search for structural stability has been uncovered. From its history, the procedure of skeletal system, building materials, unique elements, as compared to the new ones of selected churches have proved the factors behind its strength distinctively. Outstanding features were narrowed down to what is the most important: the evaluation of the structural integrity of a Century old Filipino Church. Parameters in identifying its strength were divided according to the purpose and its contribution to the whole structure. These churches possess a native character that emphasizes the use of indigenous materials, building methods that consider its geographical and geological setting. Philippines' architecture is a mixture of different influences. It might be defined through religion, regional traditions, social characteristics, and even resources. Through this research, it is hoped that further studies can be made to come up with a design parameter to create an effective massive structure such as a church that considers factors affects its structural integrity. There will be many options, but the creativity and suitability of elements should be expressed.

The dynamics of this Philippine Churches have evolved, and through innovation and modernization, change will continue to take place. With the creation of these spaces, the love for our cultures is strengthened, and the replication of these spaces will be passed to our future generations.

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